UNIVERSITY OF PENNSYLVANIA

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CLYDE A. LYNCH

A THESIS

IN PSYCHOLOGY

PRESENTED TO THE FACULTY OF THE GRADUATE SCHOOL IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY

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THE MEMORY VALUES OF CERTAIN ALLEGED EMOTIONALLY TONED WORDS

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Affective psychology is gradually attracting to its peculiar and related problems experimentalists who are ambitious to subject the feelings and emotions to controlled laboratory conditions and quantitative measurements. Just as Ebbinghaus attacked certain problems involving the 'higher mental processes,' and, by the application of precise scientific methods, was able to treat and express his results statistically, so there is an increasing number of investigators who are attempting to rescue the problems of affective psychology from the mysterious cellar of the psychoanalyst, and make them amenable to objective investigation and mathematical formulation.

The Freudian interpretation of forgetting has influenced the conceptions and practices of many psychiatrists and clinical psychologists. As H. Meltzer [1] has indicated, "there is an obvious relation between this concept and the law of effect of educational psychologists." Thorndike's [2] 'Law of Effect' attributes to the state of satisfaction or pleasure that accompanies the successful consummation of an act, a sort of retroactive effect that tends to strengthen and 'fix' the preliminary and successive movements necessary to the final adequate reaction. Inversely, the inadequate steps in the process are weakened and tend to be eliminated. The pleasure attending success reenforces the means of achieving that success, while the unpleasantness associated with failure or punishment weakens the tendencies of false movements to recur.

[1] H. Meltzer, The present status of experimental studies on the relationship of feeling to memory, *Psychological Review*, 1930, 37, 124.

[2] E. L. Thorndike, *Educational Psychology*, vol. III.

The experimentalist is also asking whether or not memories of pleasant experiences have a stronger survival value than the memories of unpleasant experiences. Why do some responses 'stick', and why do others 'drop out' in the learning process? Such inquiry is related to the basic problems of learning. A recent summary, interpretation, and evaluation of the accumulated researches into the relation of feeling to memory are included in a recent article by H. Meltzer,[3] to whose excellent bibliography the reader is referred in lieu of its repetition here. This article is especially serviceable in providing an orientation in the experimental methods and conclusions of the more important investigators who have endeavored to ascertain by scientific procedure the alleged relationship between feeling and memory.

Smith [4] and Jones [5] used the psychogalvanometer to obtain quantitative measurements of the 'emotional' values of certain words taken from Jung's [6] list. Both investigators then tested these words with respect to their memory values. Smith employed the method of retained members, and ascertained the survival values of the words at various time intervals. Jones used the method of immediate reproduction. Jones' experiments yielded results that were confirmitory of Smith's findings at Cambridge; evidence which, according to Jones, "supports a theory of the bidirectional influence of emotional tone upon memory; an increased emotional intensity may affect learning either favorably or adversely, depending on whether the emotion is 'positive' or 'negative'."

Statement of the Problem.—Smith [7] and Jones [8] have furnished an objective rating of the 'emotional' values of sixteen words. We have in addition the memory scores for these sixteen words, which were obtained by Jones from Columbia

[3] *Op. cit.* (1), pp. 124–139.

[4] Whatley Smith, *The Measurement of Emotion.* London: Kegan Paul, Trench, Trubner & Co., Ltd.; New York: Harcourt, Brace & Co., 1922.

[5] Harold Ellis Jones, Emotional factors in learning, *The Journal of General Psychology,* 1929, 11, 263–272.

[6] C. G. Jung, *Studies in Word Association.* (Trans. by M. D. Eder.) New York: Moffat, Yard; London: Heinemann, 1919, p. vii.

[7] Whatley Smith, *op. cit.*

[8] Harold Ellis Jones, *op. cit.*

and California students. The present point of departure lies in the use of the recognition method as the means of obtaining the memory scores of each of these sixteen words. Jones has advocated the use of this method for further testing the validity of his results. A larger number of observers have been used and additional data in memory scores covering a period of three weeks have been procured. This check experiment has been performed with three specific questions in the mind of the experimenter:

1. Do the words that have a high P.G.R. value also score relatively high in memory tests?

2. Is there a significant correlation between the memory scores of this experiment and the memory data of Jones?

3. Is the so-called 'emotional tone' bidirectional in its influence in the memory process?

Description of Experimental Conditions:

1. *Apparatus: A.* Four sets of white exposure cards, 10′ × 6′. Each set was bound at the bottom with adhesive tape. A succession of indentations at the top of each set facilitated the manipulation of the cards in serial presentation. Each card contained black adhesive letters arranged to form a word. Sixteen cards in each series contained eight critical words and the same number of non-critical words. Two buffer words preceeded and two followed the selected words. The critical and non-critical words were arranged in the series alternately. The words of the first set were arranged as follows:

HAND	INSULT	PENCIL	LOVE
CHAIN	CARROT	WOMAN	GLASS
WORK	DANCE	SWIM	MONEY
MARRY	TABLE	AFRAID	RUN
FLOWER	KISS	WHITE	EGG

This set constituted the forward presentation series used in testing approximately one-half the men in immediate recognition. The second set was similar to the first with one important exception. Since this set was prepared for the testing of one-half the women in immediate recognition, the word 'man' was substituted for the word 'woman' on the twelfth card. The third set contained all the words of set I in reverse order, and was used for testing half the men in immediate recognition. The fourth set contained all the words of set II in reverse order, and was used to test half the women in immediate recognition.

B. The memory testing material consisted of 1200 sheets of white paper, 11′ × 8½″, on which 100 words (A modified Jung's [9] list) were printed in four vertical columns of twenty-five words each. Among these words were the sixteen words contained on the exposure cards. They were scattered irregularly throughout the list. Half of these sheets of paper contained the word 'woman', and half the word 'man.' The sheets

[9] C. G. Jung, *op. cit.*

used for the reverse presentation memory test contained the one-hundred words in reverse order.

2. *Observers:* 1080 students coöperated in this experiment. 929 of them were students in the University of Pennsylvania, all pursuing courses in psychology, the majority of them taking the elementary courses. They were an unselected group of students from the Graduate School, the College, the School of Education, the Wharton School of Finance and Commerce, and the College Course for Teachers. The remaining 151 observers were students in the University of Dayton, Dayton, Ohio, the most of whom had taken an elementary course in psychology. Since there were no significant differences in the scores of the two institutions, no attempt has been made to preserve the identity of the Dayton group. Their results have been merged with the Pennsylvania group in the results of 'immediate recognition.' 527 observers were men, and 553 were women. The tests were made during the school year of 1929–1930.

3. *Method of Procedure: A.* The test was given to comparatively small groups of students. Instructors assisted in maintaining standard test conditions. The set of exposure cards rested on a stand or table in full view of the observers. The experimenter stood behind the stand and manipulated the cards, causing each one to drop to a right angle position, where they lay with their planes parallel to the surface of the table. There was a cover card that kept the first buffer card concealed until the proper time. Using the appropriate set of exposure cards for a given group, the experimenter would say to them: "I am about to show you a number of words. You will observe each word very carefully. Are you ready?" The cards were then exposed at the rate of two seconds per card.

B. When the memory test was given immediately following the presentation of the words, the instructions were: "I have given you a sheet of paper on which a number of words are printed. Beginning with the first word, you will proceed through the list, placing a check mark in front of each word that you recognize as having belonged to the original series." There was no time limit. Very few consumed more than five minutes.

For the groups who took the memory test at different week intervals following the exposure of the words, the phraseology was varied to suit the time interval.

When all of a group had finished checking the words on the recognition sheet, the papers were collected, and the results tabulated.

Results.—The number of words recognized immediately was 4837, or 69.33 percent. The men recognized 68.03 percent, and the women, 70.74 percent. The correlations between the rank orders of the Pennsylvania recognition scores and the P.G.R. results obtained at Cambridge and Columbia are .6361 ± .038 and .639 ± .049 respectively. Table I presents the comparison of Pennsylvania recognition values with the P.G.R. data. The latter represent the average deflections computed on the basis of the highest word as 100. The comparison of the rank orders of the scores is indicated in Table III. The Pennsylvania men's results correlate with the Cambridge P.G.R. values, .5497 ± .048; with the Columbia P.G.R. values, .526 ± .061. The Pennsylvania women

produced scores that correlate with the Cambridge P.G.R. values, .6464 ± .042; with the Columbia P.G.R. values, .518 ± .064.

TABLE I

A Comparison of P.G.R. Values and Immediate Recognition Scores

Stimulus Words	Mean Deflection P.G.R.		Recognition Scores in Percentages		
			Pennsylvania		
	Cambridge	Columbia	226 Men	210 Women	436 Both
Kiss	100	100	87	96	91
Love	82	93	80	86	83
Marry	80	69	90	89	89
Woman-man	55	90	80	69	74
Dance	51	63	66	68	67
Afraid	50	79	57	64	60
Money	48	66	70	76	73
Insult	44	74	64	76	70
Table	25	36	48	56	52
Work	25	59	49	54	51
Carrot	25	58	84	80	82
White	24	41	54	59	56
Glass	24	46	66	63	64
Flower	22	53	60	67	63
Pencil	21	40	54	61	57
Swim	19	29	71	68	69

TABLE II

A Comparison of Immediate Reproduction and Recognition Scores

(Percentages)

Stimulus Words	Columbia	California			Pennsylvania		
	100 Men	38 Men	76 Women	114 Both	226 Men	210 Women	436 Both
Kiss	98	68	67	67	87	96	91
Love	87	36	43	41	80	86	83
Woman-man	87	60	64	63	80	69	74
Carrot	82	28	52	45	84	80	82
Marry	81	38	35	40	90	89	89
Swim	64	36	41	39	71	68	69
Table	59	15	27	23	48	56	52
Money	58	26	34	31	70	76	73
Dance	57	52	41	44	66	68	67
Pencil	56	36	30	32	54	61	57
Work	55	34	34	34	49	54	51
Insult	51	28	39	35	64	76	70
White	51	23	21	22	54	59	56
Glass	50	21	26	23	66	63	64
Flower	41	36	28	31	60	67	63
Afraid	32	11	21	17	57	64	60
Averages	63.06	34.25	37.68	36.68	67.5	70.75	68.81

TABLE III

COMPARISON OF RANK ORDERS—P.G.R. AND MEMORY DATA

Stimulus Words	P.G.R. Cambridge	P.G.R. Columbia	Immediate Recall				Immediate Recognition		
			Columbia		California		Pennsylvania		
			M	M	W	B	M	W	B
Kiss	1	1	2	1	1	1	1	1	1
Love	2	2	2.5	5.25	4	5	4.5	3	3
Marry	3	6	5	4	8	6	1	2	2
Woman-man	4	3	2.5	2	2	2	4.5	7	5
Dance	5	8	9	3	5.5	4	8.5	8.5	9
Afraid	6	4	16	16	15.5	16	12	11	12
Money	7	7	8	12	9.5	11.5	7	5.5	6
Insult	8	5	12.5	10.5	7	8	10	5.5	7
Table	9.33	15	7	15	13	13.5	16	15	15
Work	9.33	9	11	9	9.5	9	15	16	16
Carrot	9.33	10	4	10.5	3	3	3	4	4
White	12.5	13	12.5	13	15.5	15	13.5	14	14
Glass	12.5	12	14	14	14	13.5	8.5	12	10
Flower	14	11	15	5.25	12	11.5	11	10	11
Pencil	15	14	10	5.25	11	10	13.5	13	13
Swim	16	16	6	5.25	5.5	7	6	8.5	8

Table II is a comparison of the Columbia, California, and Pennsylvania memory data. The percentages of the Columbia men and the Pennsylvania men show a correlation of the order of .698 ± .029. The correlation between the California men and the Pennsylvania men is .539 ± .055. The results of the California women and the Pennsylvania women correspond to the degree of .7353 ± .028. The correlation between the totals of California and Pennsylvania is .734 ± .023. The rank orders of the memory scores are presented in Table III. The Columbia group is superior to California in the score of each word. Comparisons between the Pennsylvania and Columbia male groups (see Table IV) show that the former has a very slight lead over the latter with respect to the 'positive-toned' words. Pennsylvania scored higher by 45.78 percent in its average for the 'negative-toned' words; also 5.67 percent higher in the number of non-critical words remembered. The superiority of the Pennsylvania men in their memory scores over Columbia is due largely to their higher averages for the 'negative' and non-critical words, especially the former. A comparison of the Pennsylvania

and California men reveals a marked superiority in favor of the former in the memory scores for the three classes of words. The Pennsylvania women show the same superiority in their memory scores. The Pennsylvania groups are too heterogeneous to permit any comparison of learning ability on the basis of these scores. It is assumed that the difference is due in the main to the greater efficiency of the recognition method over that of free reproduction.

Tables IV and V are given for the purpose of providing

TABLE IV

Comparison of Averages for the Three Types of Words

	Critical		Non-Critical
	Positive	Negative	
Columbia Men			
Immediate reproduction	78.00	41.50	57.25
California			
Immediate reproduction			
Men	46.66	19.50	28.62
Women	47.33	30.00	32.37
Both	47.66	26.00	31.12
Pennsylvania			
Immediate recognition			
Men	78.83	60.50	60.75
Women	80.66	70.00	63.50
Both	79.50	65.00	61.75
Pennsylvania			
One Week			
Men	57.50	26.00	22.75
Women	65.83	31.50	29.87
Both	61.50	28.50	26.00
Pennsylvania			
Two weeks			
Men	57.83	14.50	24.87
Women	62.33	26.00	28.62
Both	60.16	20.00	26.62
Pennsylvania			
Three weeks			
Men	53.33	23.00	23.50
Women	61.66	21.00	30.75
Both	58.16	21.50	27.75

data relative to the alleged bidirectional influence of affective tone; also, to permit a comparative study of the different memory values of the critical and non-critical words.

TABLE V

Comparison of Variations from the Mean

Words	Pennsylvania			California			Columbia
	Men	Women	Both	Men	Women	Both	Men
Kiss	19.5	25.25	22.19	33.75	29.32	30.32	34.94
Love	12.5	15.25	14.19	1.75	5.32	4.32	23.94
Woman-man	12.5	− 1.75	5.19	25.75	26.32	26.32	23.94
Carrot	16.5	9.25	13.19	− 6.25	14.32	8.32	18.94
Marry	22.5	18.25	20.19	3.75	− 2.68	3.32	17.94
Swim	3.5	− 2.75	.19	1.75	3.32	2.32	.94
Table	−19.5	−14.75	−16.81	−19.25	−10.68	13.68	− 4.06
Money	2.5	5.25	4.19	− 8.25	− 3.68	− 5.68	− 5.06
Dance	− 1.5	− 2.75	− 1.81	17.75	3.32	7.32	− 6.06
Pencil	−13.5	− 9.75	−11.81	1.75	− 7.68	− 4.68	− 7.06
Work	−18.5	−16.75	−17.81	− .25	− 3.68	− 2.68	− 8.06
Insult	− 3.5	5.25	1.19	− 6.25	1.32	− 1.68	−12.06
White	−13.5	−11.75	−12.81	−11.25	−16.68	−14.68	−12.06
Glass	− 1.5	− 7.75	− 4.81	−13.25	−11.68	−13.68	−13.06
Flower	− 7.5	− 3.75	− 5.81	1.75	−13.68	− 5.68	−22.06
Afraid	−10.5	− 6.75	− 8.81	−23.25	−16.68	−19.68	−31.06

While the recognition method is more efficient than the method of free reproduction in the number of words remembered, its efficiency is lowered considerably when the large number of words marked incorrectly is taken into consideration. Table VI indicates the number of words marked as

TABLE VI

Proportion of Correct and Incorrect Words in the Total Amount of Words Checked

	Immediate			One Week			Two Weeks			Three Weeks		
	226 Men	210 Women	436 Both	100 Men	100 Women	200 Both	108 Men	100 Women	208 Both	93 Men	143 Women	236 Both
Correct...	2460	2377	4837	579	697	1276	622	655	1277	514	941	1455
Incorrect.	714	496	1210	700	828	1528	854	1078	1932	678	1253	1931
Total....	3174	2873	6047	1279	1525	2804	1476	1733	3209	1192	2194	2194
Proportionate Percentages												
Correct...	78	83	80	45	46	46	42	38	40	43	43	43
Incorrect.	22	17	20	55	54	54	58	62	60	57	57	57

having been recognized by the observers; also, a comparative tabulation revealing what proportion of the words checked were correct and incorrect with reference to the total number of words marked. The correct words show the following succession of proportionate percentage gains and losses for the various time intervals (both sexes): beginning with 80 percent, the proportion of words immediately recalled, there is a loss of 42.5 percent at the end of one week; a loss of 50 percent at the end of the second week; and of 46.25 percent at the end of the third week. The proportion of words marked incorrectly begins with 20 percent and gains 170 percent at the end of the first week; 200 percent at the end of the second week; and 185 percent at the end of the third week.

Tables VII and VIII furnish additional data. Scores are

TABLE VII

Comparison of Scores for Different Time Intervals
(Forward Presentation Only)

Stimulus Words	Immediate			One Week			Two Weeks			Three Weeks		
	100 Men	100 Women	200 Both	100 Men	100 Women	200 Both	108 Men	100 Women	208 Both	93 Men	143 Women	236 Both
Kiss	86	99	93	75	83	79	73	68	71	69	78	74
Love	75	88	82	64	78	71	62	67	64	57	71	65
Woman-man	81	83	82	54	49	51	59	62	61	56	54	55
Carrot	77	78	78	21	41	31	26	26	26	27	38	33
Marry	94	99	97	72	92	82	74	81	77	71	80	76
Swim	69	76	73	34	34	34	27	31	29	24	29	27
Table	46	59	53	20	27	23	31	37	34	32	38	35
Money	73	71	72	44	61	52	45	50	48	40	55	49
Dance	66	72	69	36	32	34	34	46	40	27	32	30
Pencil	47	66	57	29	27	28	24	26	25	28	31	30
Work	39	58	49	21	34	27	19	22	21	15	25	21
Insult	63	78	71	30	40	35	13	30	21	26	22	23
White	38	53	46	12	13	12	13	19	16	10	12	11
Glass	57	59	58	16	21	18	26	23	24	13	26	21
Flower	63	80	72	29	42	35	32	45	38	39	47	44
Afraid	58	69	64	22	23	22	16	22	19	20	20	20

indicated for each word over a period of three weeks. While these results cannot be compared with the scores obtained from the two presentations employed in immediate recognition, they do, however, yield some important information. Without any interference produced by disturbing factors when the order of the words is reversed, they lend themselves to a

TABLE VIII

COMPARISON OF RANK ORDERS

PENNSYLVANIA

(SAME ORDER OF PRESENTATION)

Series Position	Stimulus Words	Immediate			One Week			Two Weeks			Three Weeks		
		Men	Women	Both	Men	Women	Both	Men	Women	Both	Men	Women	Both
2	Marry....	1	1.5	1	2	1	1	1	1	1	1	1	1
8	Kiss.....	2	1.5	2	1	2	2	2	2	2	2	2	2
10	Woman-man.....	3	4	3.5	4	5	5	4	4	4	4	5	4
5	Carrot....	4	6.5	5	12.5	7	10	10.5	11.5	10	9.5	7.5	8
14	Love.....	5	3	3.5	3	3	3	3	3	3	3	3	3
16	Money....	6	10	7	5	4	4	5	5	5	5	4	5
11	Swim.....	7	8	6	7	9.5	8.5	9	9	9	12	11	11
6	Dance....	8	9	10	6	11	8.5	6	6	6	9.5	9	9.5
3	Flower....	9.5	5	8	9.5	6	6	7	7	7	6	6	6
4	Insult.....	9.5	6.5	9	8	8	7	15.5	10	13.5	11	14	12
12	Afraid....	11	11	11	11	14	14	14	15.5	15	13	15	15
15	Glass.....	12	13.5	12	15	15	15	10.5	14	12	15	12	13.5
9	Pencil.....	13	12	13	9.5	12.5	11	12	11.5	11	8	10	9.5
7	Table.....	14	13.5	14	14	12.5	13	8	8	8	7	7.5	7
1	Work.....	15	15	15	12.5	9.5	12	13	15.5	13.5	14	13	13.5
13	White.....	16	16	16	16	16	16	15.5	16	16	16	16	16

comparative study of each word in the four sets of scores. Table VIII reveals a fair consistency of the several scores from the beginning to the end of the three-weeks' period. In the rank orders for the totals for both sexes, there is a remarkable uniformity. The words 'marry', 'kiss', and 'white' register no change in rank order. The other words show the following ranges in their respective rank orders: 'love', .5; 'woman'–'man' and 'work', 1.5; 'flower', 2; 'money', 'afraid', and 'glass', 3; 'pencil', 3.5; 'dance', 4; 'carrot' and 'swim', 5; 'insult', 6.5; and 'table', 7. In each time interval there are high correlations between the scores of the two sexes: immediate, .9162 ± .008; one week, .841 ± .020; two weeks, .882 ± .015; and three weeks, .9493 ± .0064. A comparison of Tables III and VIII will reveal no radical shifts in the rank orders due to the reversal of the order of serial presentation. Nevertheless, there is much evidence that the secondary laws of association were operative as one would expect. Table IX shows both the differences in rank order and the variations from the mean in the two serial orders

TABLE IX

VARIATIONS FROM THE MEAN AND IN THE RANK ORDER ASSOCIATED WITH THE DIFFERENCE OF WORD POSITION IN THE SERIES

226 Men

Words	Position in Series		Rank Order of Scores		Variation from Mean		Difference in Amount of Variation	
	First	Second	First	Second	First	Second	Rank-order Change	Mean
	Presentation		Presentation		Presentation			
Marry	2	15	1	2	29.5	15	−1	14.5
Kiss	8	9	2	3	21.5	17	−1	4.5
Woman	10	7	3	5	16.5	8	−2	8.5
Carrot	5	12	4	1	12.5	21	3	8.5
Love	14	3	5	4	10.5	14	1	3.5
Money	16	1	6	9	8.5	− 4	−3	12.5
Swim	11	6	7	7	4.5	2	0	2.5
Dance	6	11	8	10.5	1.5	− 5	−2.5	6.5
Insult	4	13	9.5	10.5	− 1.5	− 5	−1	3.5
Flower	3	14	9.5	14	− 1.5	−13	−4.5	11.5
Afraid	12	5	11	15	− 6.5	−15	−4	8.5
Glass	15	2	12	6	− 7.5	4	6	11.5
Pencil	9	8	13	12	−17.5	− 9	1	8.5
Table	7	10	14	16	−18.5	−21	−2	2.5
Work	1	16	15	13	−25.5	−11	2	14.5
White	13	4	16	8	−26.5	0	8	26.5

210 Women

Marry	2	15	1.5	5	24.75	12.3	−3.5	12.45
Kiss	8	9	1.5	1	24.75	25.3	.5	.55
Love	14	3	3	2	13.75	16.3	1	1.55
Man	10	7	4	13.5	8.75	−12.7	−9.5	21.45
Flower	3	14	5	13.5	5.75	−12.7	−8.5	18.45
Carrot	5	12	6.5	3	3.75	14.3	3.5	10.55
Insult	4	13	6.5	6	3.75	7.3	.5	3.55
Swim	11	6	8	10	1.75	− 6.7	−2	8.45
Dance	6	11	9	8.5	− 2.25	− 2.7	.5	.45
Money	16	1	10	4	− 3.25	13.7	6	16.95
Afraid	12	5	11	11	− 5.25	− 7.7	0	2.45
Pencil	9	8	12	12	− 8.25	−10.7	0	2.45
Glass	15	2	13.5	7	−15.25	− .7	6.5	14.55
Table	7	10	13.5	15	−15.25	−14.7	−1.5	.55
Work	1	16	15	16	−16.25	−17.7	−1	1.45
White	13	4	16	8.5	−21.25	− 2.7	7.5	18.45

for both sexes. However, there is no uniformity, and even some anomolies. With both sexes, 'marry' and 'flower' had their scores reduced considerably by reason of their being changed from the early to the latter positions. 'White' gained the greatest amount of all when changed from the

13th position to the 4th, and 'glass' made a significant gain in going from the 15th place to the 2d. 'Money' presents a peculiar case. In the male score its variation from the mean amounted to 12.5 points, making the variation minus as the result of its being advanced from the last to the first place in the series, as though the factor of recency were operating more effectively than that of primacy; but when the score obtained by the women for the same word is inspected, it represents a plus variation difference of 16.95 points, as the result of the identical change in position. Among the men, 'work' reduced its minus variation 14.5 points when carried forward from the first to the last place in the series; among the women it increased its minus variation 1.45 points. It is difficult to explain why this word, the first in the series, preceeded by only two buffer words should have a rank order of 15. In the combined scores of the two orders of presentation, where the laws of primacy and recency would be expected to operate, it has the lowest rank order of the series. It is also difficult to explain why the word 'man' increased its variation 21.45 points, making its variation minus, in its shift from the 10th to the 7th position in the series, as scored by the female observers. Contradictory scores are further illustrated by 'carrot' and 'swim': among the women the former word increased its plus variation by 10.55 points when it was set back from the 5th to the 12th place; the latter word varied 8.45 points in its advancement from the 11th to the 6th place, making its variation minus.

Discussion.—How do the results of this experiment compare with former experimental results? The Pennsylvania memory results reveal a fair degree of correlation between the sixteen words employed and the P.G.R. values obtained by Smith and Jones for the same words, and a much higher degree between the memory values and the memory data obtained by Jones at Columbia and California. The Pennsylvania results agree with Cambridge, Columbia, and California in the higher scores obtained by the majority of the 'positive' words, even though the same degree of difference does not exist between the 'positive' and the 'indifferent' words.

The Pennsylvania range is not as extensive as that of the scores of Columbia and California. The results of this experiment are also in harmony with the conclusions of Tait,[10] Myers,[11] Tolman and Johnson,[12] Washburn and others,[13–17] namely, that stimuli with a pleasant feeling tone are better remembered than others. The chief difference between the results of this experiment and those of Jones' is associated with the higher scores Pennsylvania gave to the 'negative' words in immediate recognition. These words scored considerably higher than the scores for the same words at California, and are superior to Columbia in the same respect to a lesser degree. At Pennsylvania, the averages for the scores of the two 'negative' words for both sexes are higher than the averages of the non-critical words. This supports Tait's conclusion that the memory values of unpleasant stimuli rate higher than those of indifferent stimuli. In the additional material provided by the forward presentation the first week's average of the 'negative' words is higher than that of the non-critical words. The former, however, drops 13 percent between the first and second week intervals, and in the latter and the third week, are considerably below the scores of the non-critical words.

These conclusions are invalidated somewhat by the paucity

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of 'negative' words in the list. In the 'positive' and non-critical classes of words one or two words may deviate from the class characteristics without affecting the averages materially. The averages of 'carrot' and 'swim', for example, are higher than the averages of the 'positive' words, 'dance' and 'money'. If it happened that the pair of words were representative of the classes to which they belong, one would be bound to conclude on the basis of the results that non-critical words are better remembered than 'positive' words. An experiment in which the alleged differently toned words were used in equal numbers would be more convincing in its results. Two words may give a spurious average in either direction.

An examination of the averages derived from the combined scores of the members of the three classes of words, indicated for each one of the four time intervals, will reveal a marked decrease in the number of words remembered at the end of the first week. The 'positive' words, which averaged 79.50 percent in immediate recognition, decreased 22.6 percent at the end of the first week; by the end of the second week, they lost an additional 1.7 percent, or 24.3 percent of the score of immediate recognition. These words registered 28.8 percent in the third week's results, a decrease of 4.5 percent below the score of the second week's interval. The greatest drops in the averages occurred in connection with the 'negative' words. In immediate recognition and the first week's interval these two words averaged higher than the non-critical words. With an average of 65 percent in immediate recognition, they sustained a loss of 56.1 percent in the first week's test. The second week yielded an average of 69.1 percent less than that of immediate recognition. There was a slight recovery in the third week, where the average score was 66.9 percent of the immediate recognition results. The average of the non-critical words was reduced by 57.8 percent the first week, with slight recoveries in the second and third weeks, the losses being 56.8 percent and 55 percent respectively. These results, in general, confirm with previous experimental data on forgetting. From immediate recognition to the end of

the first week there is a considerable drop in the percentage of words remembered. After the first week the rate of decrease is very slow, and within the limits of this experiment, is practically at a stand-still. The exception to the rule in our present results is in the 29.8 percent drop of the 'negative' words from the first to the second week, these results lend some support to the theory that 'positive' words have a greater survival value than 'negative' and non-critical words, and that 'negative' words have a lesser survival value than all other words, provided that a sufficient time interval elapse to prevent the operation of memory-span and temporary associative factors. With the passing of time, according to this theory, the 'negative' words should lose most; the non-critical words less; and the 'positive' words least. Since the recognition method involves the representation of the stimuli, we would expect all classes of words to obtain higher scores than those obtainable by the method of free reproduction. The present experimental data confirm this position.

On the basis of the P.G.R. ratings which separate the words into the 'critical' and 'non-critical' categories, the memory scores for all three universities are in approximate agreement. While the placement of the individual words may vary, there is significant correspondence in the inclusion of the majority of the 'positive' words in the upper fifty percent of rank orders. In these upper eight rank orders, Columbia includes all the critical words but 'insult', 'dance', and 'afraid'. California includes all but 'money' and 'afraid'. Pennsylvania includes all but 'dance' and 'afraid'. 'Afraid' is eliminated by all; 'carrot' and 'swim', non-critical words, are included by all. 'Dance' is not included by Columbia and Pennsylvania. Columbia gives 'table' seventh place, constituting an exception. If it be said that these results support the bidirectional theory of affective tone, as has already been pointed out, our Pennsylvania scores do not justify anything beyond the assertion that these 'negative' words are more poorly remembered than the 'positive' words, but that they are not inferior in survival value to the 'indifferent' words until the second and third weeks. Furthermore, if a bidi-

rectional theory is supported on the basis of the comparatively low scores of the two 'negative' words, what is to be said with reference to the exceptionally high value of 'carrot' and the relatively high value of 'swim'. In regard to these two words, Jones offers no explanation for their high memory values, "although", he suggests, "a determined seeker after symbols might attribute it to a partially hidden sexual significance of the words, which could affect the process of memorizing without, however, becoming manifest within the stimulus-response periods of an association experiment." It appears to the writer that the word 'swim' is in a more direct associational relation to the sex words of the series than 'carrot'; for it possesses sexual connotations derived from its association with mixed and promiscuous bathing, and is related to the idea of nudeness; yet this word has a lower memory value than the word 'carrot', whose natural associations with the sex words of the series are practically zero. More indirect and symbolic associations are operative here, if a sexual explanation is to be forced. For example, a person with red hair is often nicknamed 'carrot' or 'carrot-top'. The popular association of red hair with sexual passion is one of common knowledge. But why not refer its high memory value to the nutritive function of life? 'Carrot' is very highly recommended as an important article of diet, and many persons eat carrots, not for their taste, but in spite of their taste, believing them to assist in promoting their health, and increasing their chances of longevity. Furthermore, on the basis of the clearness of the image, the word 'carrot' is more likely to call up a more specific image than the more general words of 'table', 'glass', 'white', 'work', 'flower', etc.

With respect to sex differences the Pennsylvania results agree with California in rating the women higher in the number of words remembered. The similarity is striking. The Pennsylvania women averaged 3.25 percentage points higher than the men; the California women averaged 3.43 percentage points higher than the men. The Pennsylvania women exceeded the men in memory scores throughout all the time intervals with the exception of the third week, where the

women remembered fewer 'negative' words than the men. In the proportion of correct and incorrect words to all the words marked, there is no significant sex difference. As the results show, there is a very high correlation between the sexes in the rank order placements of the sixteen words. The same high degree of correlation obtains in the scores of the California men and women.

Conclusions.—1. There is a fair degree of correlation between the total Pennsylvania immediate recognition scores and the P.G.R. values obtained by Smith (.636 ± .038) and Jones (.639 ± .049) for sixteen words selected from Jung's list.

2. There is a fairly high correlation between the score obtained by the Pennsylvania men in immediate reproduction and the immediate reproduction scores of the Columbia men (.698 ± .029). The degree of correlation between the combined scores of men and women at Pennsylvania and California is .734 ± .023. Consequently, this check experiment has yielded results by the use of the recognition method which are in general agreement with the results obtained by Smith and Jones, who employed the reproduction method.

3. The experimental evidence of this study does not give much support to Smith's theory of the bidirectional effect of emotional influence in recall. The 'negative' words were remembered more poorly than the most of 'positive' words, but averaged higher than the averages of the non-critical words in immediate recognition and the first week interval.

4. The superior memory scores of Pennsylvania are most likely due to the greater efficiency of the recognition method, especially with reference to the 'negative' and the non-critical words.

5. There is a considerable loss in forgetting at the end of the first week; but, thereafter, the differences in the scores for the different intervals were practically negligible. The 'negative' words were affected most in the losses sustained.

6. With the exception of the results obtained immediately after the presentation of the words, in the number of words marked, there were more errors than correct selections. The words marked incorrectly seem to show the operation of some determining factor.

7. While the women remember more words than the men, there are no indications of any significant sex difference, except that in immediate recognition the women remembered the word 'man' less efficiently than the men remembered the word 'woman'. The correlation between the scores of the two sexes for the four time intervals is very high.

8. The position of the words in the series affected their respective scores. This was especially true of certain non-critical words. The 'positive' words did not fluctuate very significantly. The scores of the two orders of presentation were combined and averaged to eliminate the influence of position in the series.

9. The inclusion of approximately the same words in the upper fifty percent for Columbia, California, and Pennsylvania, lends strong support to Smith's results and contention that words having a high P.G.R. value will also have a high memory value. (According to Smith, 'negative' words constitute an exception.)

10. Two of the words classified as non-critical have an unusually high memory value. These words are 'carrot' and 'swim'. These results correspond with Jones' results at Columbia and California.

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